Source: CLHLS research team (2000). Databook of the 1998 CLHLS. Pp17-25. Beijing: Peking University Press.

CHAPTER 5 WEIGHTING METHOD

Our 1998 healthy longevity survey tried to interview all centenarians who voluntarily agreed to participate in the survey, in the randomly selected half of the counties and cities of the 22 provinces. For each centenarian, one nearby octogenarian (aged 80-89) and one nearby nonagenarian (aged 90-99) with pre-designed age and sex were matched and interviewed. We tried to have approximately equal numbers of male and female octogenarians and nonagenarians at each age from 80 to 99. We did not follow the procedure of proportional sampling, in order to avoid the errors of random fluctuation due to too small sample size at more advanced ages, especially for males. Consequently, appropriate weights should be used to compute the overall average for the oldest old persons age 80+ and the averages of the age groups (e.g. 80-89 and 90-99).

The age (x), sex (s), and rural-urban residence (r) specific weight w(x,s,r) is computed as:

$$w(x,s,r) = [\ N(x,s,r) / \sum_x\sum_s\sum_r N(x,s,r)\ ] / [\ n(x,s,r) / \sum_x\sum_s\sum_r n(x,s,r)\ ]$$
$$= [N(x,s,r) / n(x,s,r)\ ] * [\sum_x\sum_s\sum_r n(x,s,r) / \sum_x\sum_s\sum_r N(x,s,r)\ ]$$

N(x,s,r) is number of persons of age x, sex s, and residence r, derived from projected 1998 oldest old population based on the 1990 census 100% data tabulations for the 22 provinces where the 1998 survey was conducted, and the estimated age-sex-specific survival probabilities between 1990 and 1998. We have no age-specific data about rural-urban migration between 1990 and 1998. We, therefore, used the overall proportion of urban population age 80+ (0.378) derived from our 1998 survey, which is the same as our expert estimate of the urbanization level in the 22 provinces in 1998, to adjust the projected 1998 rural-urban distribution. The n(x,s,r) is number of persons of age x, sex s, and residence r, derived from the 1998 healthy longevity survey. The weight is actually the multiplication of the ratio of [N(x,s,r) / n(x,s,r)] and the factor [$\sum_x\sum_s\sum_r$ n(x,s,r) / $\sum_x\sum_s\sum_r$ N(x,s,r)]. The factor is the overall sampling ratio. No weights are needed when we compute the average of the centenarians age 100-105, since the survey attempted to interview all centenarians in the sampled areas. We did not include the very few cases of super-centenarians of age 106 and above due to possibility of questionable quality of their age reporting.

The weight w(x,s,r) is actually the ratio of age distribution of the entire population age 80+ in 1998 to the age distribution of the 1998 sample. The weights for the over-sampled extremely old persons (e.g. 90+) are less than 1.0, and weights for under-sampled elders (e.g. age 80-85) are greater than 1.0.

The values of the weights vary (usually greater than 1.0 under age 88 and less than 1.0 above age 90), and it produces correct proportions of certain attributes within age groups by using the weights. However, SPSS (or other software) would not produce correct p-values for testing the statistical significance of the differences of the proportions among different age groups, since the sub-sample size of the age groups are altered after weighting the individual cases. Therefore, the weights need to be adjusted to make sure that the sub-sample size within each age group after weighting is exactly the same as the true sub-sample size. Denote $C_j(s,r)$ as the adjusting factor for age group j (e.g. age group 90-95) with sex s and residence r; $T_j(s,r)$ as the total number of interviewed persons of the age group j with sex s and residence r. The following equations must be fulfilled: $C_j(s,r)*\sum_x w(x,s,r)\ n(x,s,r) = T_j\ (s,r)$. Solving this equation, we obtain the adjusting factor,

$$C_j\ (s,r) = T_j\ (s,r) / \sum_x [w(x,s,r)\ n(x,s,r)].$$

"$\sum_x$" here refers to the sum of the number of the persons over the age group (e.g. age group 90-95).

The adjusted weights are: $w'(x,s,r) = w(x,s,r) * C_j (s,r)$. We should use the adjusted weights that produce both correct proportions, and correct sub-sample sizes and thus correct p-values for testing statistical significance of the differences of the proportions among various age groups.

If one computes proportions of certain attributes of age groups with rural and urban combined, the adjusting factor is not rural-urban specific, but age group (j) and sex specific:

$$C_j (s) = T_j (s) / \sum_x \sum_r [w(x,s,r)\, n(x,s,r)].$$

If one computes proportions of certain attributes of age groups with both rural and urban combined and sexes combined, the adjusting factor is neither rural-urban specific, nor sex-specific, but only age group (j) specific:

$$C_j = T_j / \sum_x \sum_r \sum_s [w(x,s,r)\, n(x,s,r)].$$

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